

MARY K. SALCEDO, Ph.D.

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Biomechanist/Physiologist/Entomologist

insect flight, circulation and respiration, wing hydraulics, bioinspiration

CURRENT POSITION

Date	Degree/Training	Institution
2019-Present	NSF Post-doctoral Researcher Advisor: Dr. Jake Socha, Biomedical Engineering and Mechanics (BEAM) <ul style="list-style-type: none">- Measuring insect circulation, respiration, and mechanics of coupled flow systems- Synchrotron x-ray imaging at Argonne National Laboratory capturing novel information about insect physiology	Virginia Tech

EDUCATION AND TRAINING

2013-2019	PhD, Organismic and Evolutionary Biology (OEB) Advisors: L. Mahadevan, Harvard University, Professor of Applied Mathematics, Professor of OEB, and Professor of Physics Stacey Combes, UC Davis, Professor of Neurobiology, Physiology, and Behavior <i>Awarded February 27th, 2019</i> <ul style="list-style-type: none">- Modeling of insect wing geometries across insect phylogeny- Measurement of hemodynamics of circulation in insect wings- Understanding role of hydraulics of wing expansion during metamorphosis	Harvard University
2012-2013	Research Assistant at Concord Field Station	Harvard University
2007-2012	Bachelor of Science (double major) Applied Computational Mathematical Science Molecular/Cellular Biology	Univ. of Washington

FELLOWSHIPS AND AWARDS

Date	Fellowships	Source/Institution
2019 - 2021	NSF Postdoctoral Research Fellowship Category: Broadening Participation (Current) [\$138,000]	<i>Nat. Sci. Foundation</i>
2014 - 2017	NSF Graduate Research Fellowship Funded Ph.D. work [\$125,000]	<i>Nat. Sci. Foundation</i>
Nov 2019	Beamtime allocation at Argonne National Laboratory "The mechanics of circulatory flows in insect wings - Part 2" General User Program (GUP) proposal #66434 (168 hours granted at beamline 2BM) <ul style="list-style-type: none">- 3D synchrotron imaging inner insect wing vein geometries [equivalent value of \$42,000]	<i>Advanced Photon Source</i>

AWARDS

2017	Travel Scholarship for Broadening Participation Soc. for Integr. and Comp. Biology (SICB) Annual Meeting [\$500]	<i>SICB</i>
2016	Distinction in Teaching OEB 173: Comparative Biomechanics	Harvard University
2014	Distinction in Teaching Life Sciences 2: Evolutionary Human Physiology and Anatomy	Harvard University

INVITED PRESENTATIONS

Date	Seminar/Invited Talk	Institution
2021	Biology Seminar Series, Jan 29	U. of Western Ontario
2020-all below	Environ-Lunch, Oct 29	UC Merced
	Entomology Seminar, Oct 26	Cornell University
	Behavior, Ecology, and Physiology Seminar, June 3	Bangor University
	Ecology and Evolution Seminar, April 20	Wake Forest

The STEM Village: Improving networks of LGBTQ+ scientists in Scotland, April 17

Link to talk: <https://youtu.be/bSqFWZ4kcZQ>

Entomology Department Seminar, March 11

Entomology Department Seminar, Jan 30

UC Davis

Virginia Tech

PEER-REVIEWED PUBLICATIONS

Salcedo, MK, Socha, JJ. Circulation in insect wings: a review on the necessity of hemodynamics in wing functionality.

Integrative and Comparative Biology (2020). doi: 10.1093/icb/icaa124

Burnett, N.P., King, E.E., Salcedo, M.K., Tanner, R.L. and Wilsterman, K. Conference scheduling undermines diversity efforts. **Nature Ecology & Evolution (2020)**, pp.1-2. doi:10.1038/s41559-020-1276-5

Salcedo, MK, Hoffmann, J, Donoughe, S, Mahadevan, L. Computational analysis of size, shape and structure of insect wings. **Biology Open (2019)**. doi:10.1242/bio.040774

Peleg, O, Peters, JM, Salcedo, MK, Mahadevan, L. Collective mechanical adaptation of honeybee swarms. **Nature Physics (2018)** 14(12): 1193. doi: 10.1038/s41567-018-0262-1

Hoffmann, J, Donoughe, S, Li, K, Salcedo, MK, Rycroft, CH. A simple developmental model recapitulates complex insect wing venation patterns. **PNAS. (2018)** 115(40): 9905 - 9910. doi: 10.1073/pnas.1721248115

Combes, SA, Salcedo, MK, Pandit, MM, Iwasaki, JM. Capture success and efficiency of dragonflies pursuing different types of prey. **Integrative and Comparative Biology (2013)** 53(5): 787 - 798. doi: 10.1093/icb/ict072

Williams, CD, Salcedo, MK, Irving, TC, Regnier, M, TL Daniel. The length-tension curve in muscle depends on lattice spacing. **Proceedings of the Royal Society B. (2013)** Vol 280, issue 1776. doi: 10.1098/rspb.2013.0697

MANUSCRIPTS IN-PREP (drafts available upon request)

Salcedo, MK, Combes, SA, Mahadevan, L. Functional consequences of venation patterns on hemodynamics in the North American Locust (*Schistocerca americana*).

CONFERENCE PRESENTATIONS (*denotes undergraduate mentee)

Salcedo, MK, Hoffmann, J, Donoughe, SD, Combes SA, Mahadevan L. **What's in a vein? Using computational tools to explore wing diversity and functional consequences of venation patterns on hemodynamics**. Integr. Comp. Biol. (2020) SICB, Austin, TX. Symposium.

*Hardy, DJ, Salcedo, MK, Kenny, MC, Pulliam, JN, Pendar, H, Socha, JJ. **Shot through the heart: a non-invasive IR technique to measure dorsal heart pumping in insects**. Integr. Comp. Biol. (2020). Austin, TX. Poster.

Salcedo, MK, Combes, SA, Mahadevan L. **Active hemolymph flow in insect wings: characterization of uniform, bi-directional and pulsatile flow in a wing network**. Integr. Comp. Biol. (2018) Vol. 58, pp. E196. SICB, San Francisco, CA. Talk.

Salcedo, MK, Hoffmann, J, Mahadevan, L. **Wing vein topology and the hydraulics of wing expansion**. OEB G4 Symposium. Cambridge, MA. (26 - 27 April 2017). Talk.

Salcedo, MK, Combes, SA, Mahadevan L. **Wing vein networks across insect orders: examining hierarchical network structure and hemolymph flow**. Integr. Comp. Biol. (2017) SICB, New Orleans, LA. Talk.

Salcedo, MK, Combes, SA, Mahadevan L. **Wing expansion in dragonflies and field crickets: a tightly folded solution to a complex behavior**. Integr. Comp. Biol. (2016) Vol. 56, pp. E250. SICB, Portland, OR. Talk.

Combes, SA, Salcedo MK, Gagliardi, SF, Crall, JD, Iwasaki, JM, Rundle, DE. **Optimal flight speeds during dragonfly predator-prey encounters**. Integr. Comp. Biol. (2015) Vol. 55, pp. E33. SICB, West Palm Beach, FL. Poster.

MENTORING DOCUMENTS

Salcedo, MK. Undergraduate Expectations Document - working with Dr. Salcedo. doi:10.5281/zenodo.4000437

RESEARCH EXPERIENCE

Date	Position	Institution
July 2019	Postdoctoral Researcher	Virginia Tech
-Present	PI: Jake Socha	
	- Quantifying tracheae expansion/collapse and relationship to hemolymph movement	
	- Use of Advanced Photon Source to visualize complex internal physiology of insect wings and wing pads	
	- Use of Matlab/Python to analyze ultrasound recordings of dorsal heart movement in beetles	

2013-2019	<ul style="list-style-type: none"> - Formed collaboration with particle image velocimetry expert, Dr. Pavlos Davlos (Purdue) to track fluorescent particles throughout the insect body 	Harvard University
	Graduate Researcher	
	PI: Stacey Combes and L. Mahadevan	
	<ul style="list-style-type: none"> - Comparative geometric analysis of insects wings based on size, shape, and topologies of wing networks - Biomechanical analysis of hemodynamics in wings of the North American Grasshopper - Quantified auto-expansion of insect wings during metamorphosis - Determined swarm dynamics of honeybees and collective motion under wind-like mechanical motion 	
Aug. 2012 -2013	Research Assistant, Concord Field Station	Harvard University
	PI: Stacey Combes	
	<ul style="list-style-type: none"> - Field experience: catching insects, rearing nymphs to adults, monitoring dragonfly populations - Work on tracking wing bending kinematics and biological modeling through high speed video - Managed lab: ordering supplies, maintaining equipment, organizing lab environment 	
2010-2012	Undergraduate Research Assistant	Univ. of Washington
	PI: Tom Daniel	
	<ul style="list-style-type: none"> - Supported graduate research into study of biomechanics and muscle physiology - Modeled data with Python/Matlab, built experimental rig for muscle physiology and computational analysis of x-ray diffraction images - Organized, managed and assisted in conducting of a cross-disciplinary and collaborative x-ray diffraction experiment at Beamline 18-ID, Advanced Photon Source, Argonne National Laboratory, Illinois (August 2011) - Built, placed and measured electrodes in steering and flight muscles of <i>Manduca sexta</i> - Experience with high speed cameras and digital tracking 	
2009 - 2010	Undergraduate Research Assistant	Univ. of Washington
	PI: Pat Stayton	
	<ul style="list-style-type: none"> - Supported post-doctoral research into the study of water interactions with streptavidin protein - Performed protein expression on eight mutant strains of DNA - Experimental skills included: design of DNA sequences, growth of cells and insertion of DNA, gel analysis, cell lysis techniques and biotin immunoprecipitation 	

TEACHING EXPERIENCE (*virtual due to current travel restrictions)

Date	Position	Institution
Nov 2020	Guest Lecturer* , E&EB 295: Life in Motion: Eco. & Evo. Phys, Nov 16	Yale University
Oct 2020	Guest Lecturer* , BIOL 472: Form and Function Lab, Oct 5	Towson University
Aug 2020	Guest Lecturer* , Biology Dept, Asynchronous Learning Workshop, Aug 4	Virginia Tech
July 2020	Guest Lecturer* , Biology Dept, "Anti-racism education in biology," July 7	Virginia Tech
June 2020	Faculty for Cornell Summer Pre-College Program*	Cornell University
	UNIV-1110: Building intuition: Bioinspiration and foundations of design in biological systems	
	Co-faculty: Dr. Jacob Peters (Electrical and Computer Engineering, Cornell University)	
	<ul style="list-style-type: none"> - Designed, created, and led course new course to examine how engineers are inspired from biological systems, and how they build off those principles. We reviewed published bio-inspired technologies, lectured on foundational mathematical principles, and interviewed scientists behind the work. - Lectures can be viewed: http://bit.ly/foundationsOfBioinspiration 	
Feb 2020	Guest Lecturer , ESM 4106: Engineering Analysis of Physiologic Systems	Virginia Tech
	- Gave lecture on hemolymph circulation mechanisms in insects and their appendages	
Fall 2019	Guest Lecturer , ENT 5114: Insect Structure and Function	Virginia Tech
	- Gave lectures on insect appendages, appendage function, insect wings, and wing-joining mechanisms	
June 2017 & June 2018	Faculty for Harvard Summer Pre-College Program	Harvard University
	BIOS P-13540: Comparative Biomechanics and Physiology: Designing Insect-Inspired Gliders	
	- Designed and led course new course combining insect physiology, entomology and biomechanics with a focus on insect-inspired glider design. Strong focus on combining applied math/biological principles.	

- Students toured entomology collections, were led in insect dissections, learned to catch insects outdoors, make gliders based on biological observations, then mechanically test said gliders in wind tunnels and with an Instron.

Spring 2016	Teaching Fellow , OEB 173: Comparative Biomechanics	Harvard University
Fall 2014	Teaching Fellow , LS2: Evolution and Human Physiology and Anatomy	Harvard University
Fall 2014	Teaching Fellow , LS2: Evolution and Human Physiology and Anatomy	Harvard Ext. School
Sept 2010	Teaching Assistant , Engineering Bridge Program	Univ. of Washington
Summer 2010	Teaching Assistant , Initiative for Maximizing Student Diversity	Univ. of Washington

DIVERSITY, INCLUSION, AND OUTREACH EXPERIENCE

Year	Position	Institution/Org
Jan 2020 -Present	Member, BEAM Inclusion and Diversity Committee Member identifying key inclusion/diversity issues - Devises solutions, takes active role in recruiting underrepresented students, leads workshops	Virginia Tech
Jan 2020 -Present	Member, SACNAS Membership Committee <i>Society for the Advancement of Chicanos/Hispanics and Native Americans in Science</i> Member serving on sub-committee of national SACNAS organization - Focuses on retaining members and providing professional development resources	SACNAS
2019 & 2020	Lead Volunteer for Socha Lab booth at Hokie BugFest - Organized and created content for virtual "Socha Insect Story and Crafts Corner" with stories in Spanish/English, cooking and painting crafts (2020) - Designed vertical wind tunnel to "fly" fake plastic insects with variety of wing aspect ratios (2019)	Virginia Tech
Oct 2015 -May 2019	Lead Recruiter and Co-Vice President of SACNAS at Harvard Co-Vice President of SACNAS at Harvard Chapter (2016 - 2019) Lead Recruiter for Harvard OEB Dept. (2015 - 2019) - Organized departmental diversity initiatives based around the SACNAS conference - Met with other dept./school heads to organize and determine top priorities at conference - Encouraged students with diverse backgrounds to apply to Harvard and other graduate programs - Created and designed unique professional development workshops for URM students at Harvard	Harvard University
2020-Present	LGBTQIA+ Mentor at SICB - Supported and encouraged attendees who identify as LGBTQIA+ at SICB	SICB
2017-Present	Broadening Participation Mentor at SICB - Supported URM undergraduate attendees at SICB	SICB
2015-2016	Volunteer, local New England High Schools - Taught lessons by request via GradWagon (online science-connect platform) - Focused on entomology, insect collection, insect preservation, local pollinators, insect dissections Manchester High School Central, NH (April 2016) Belfast Area High School, ME — visiting Cambridge, MA (March 2016) Urban Science Academy, MA (Jan 2016) Shore Educational Collaborative/Henry Owen School, MA (May 2015) Westborough High School, MA (Nov. 2015)	
Aug 2015	Program manager of professional development workshop Concord Field Station Teacher Professional Development - Coordinated with Harvard's Life Sciences Outreach Program for 2-day workshop - Developed workshop to teach local high school teachers field-based lessons for their classroom - Cross-disciplinary work with graduate students and post-docs to design lesson plans - Designed hands-on labs for teachers to participate in, critique, and edit for their classrooms - Introduced a bee-keeping course component which many teachers implemented in their own classroom	Concord Field Station
2014-2017	Volunteer with Harvard Museum of Natural History - ArtsFirst Festival, Build-a-Bug (April 2017) - I Heart Science (Feb. 2016-2019) - Insect outreach "All about honeybees" (June 2015)	Harvard University

- Museum storytime (Nov 2014)

MENTORING EXPERIENCE

Sept 2020-Present	Mohamed Hussein, Undergraduate	Virginia Tech
	- Training in microCT image processing, 3D reconstruction, and 3D printing	
Sept 2020-Present	Terrell Worrell, Undergraduate	Virginia Tech
	- Training in decoding behavior of dragonfly take-off maneuvers	
	- Training in reconstruction of flight kinematics	
Nov 2019-Present	Yulia Kirina, Undergraduate	Virginia Tech
	- Training in insect animal care and rearing	
	- Teaching image preprocessing, segmentation and analysis of microCT data	
July 2019-Present	Donovan Hardy, Undergraduate (REU)	Morehouse College
	- Led in design of infrared device that detects dorsal vessel pumping in insects	
	- Supported and mentored at national STEM conference	
Summer 2016	Johanna Lara, High School Senior	Masconomet High
	- Led high school students in field- and collection-based entomological research at the Concord Field Station	
Summer 2016	Connor Mochi, High School Senior	Masconomet High
	- Led high school students in field- and collection-based entomological research at the Concord Field Station	

PRESS

Garvey, Kathy Keatley. "Seminar on March 11: Mary Salcedo and Insect Wings." Entomology & Nematology News: UC News about Entomology and Nematology. **10 March 2020**. <https://bit.ly/3cAe7qO>

Canon, William. "Flying Right." Harvard Gazette. **29 May 2019**. <https://bit.ly/3kVeSxC>

Salcedo, MK. "First person — Mary Salcedo." Biology Open First Person Series. **18 October 2019**. <https://bit.ly/339wmQP>

EDITORIAL AND REFEREE SERVICE

Journal of Theoretical Biology, Integrative and Comparative Biology, Journal of Material Science

PROFESSIONAL ASSOCIATIONS

Jan 2020-Present	SACNAS Membership Committee
Oct 2011-Present	Society for Integrative and Comparative Biology (SICB)
Oct 2015-Present	Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)
2016-2019	SACNAS at Harvard Chapter, Co-Vice President